ABSTRACT

THESIS: Microfacies Analysis and Hydrocarbon Potential of The Rockford/Chouteau Limestone in The Illinois Basin

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The Rockford Limestone in Indiana and its Illinois equivalent Chouteau Formation, is a thin limestone formation that overlays the New Albany Shale and is early Mississippian in age, specifically the Kinderhookian and Valmeyeran Series. This project is a part of the Frontier Basin Initiative which attempts to identify future oil and gas exploration targets in regions which currently do not have hydrocarbon production. By applying fundamental geoscience research to the Rockford, microfacies analysis will be able to explain why the Rockford Limestone does not host significant oil and gas accumulations and what exploration pathway may provide future success. Being able to recognize both the depositional facies and the diagenetic history is important in understanding the formation and preservation of carbonate reservoirs.

There are three sets of samples used in this thesis. The first is a core loaned from the Indiana Geological Survey (IGS) in Clark County, Indiana. Second, samples were taken from a local outcrop in Jerseyville Hollow, Jersey County, cutting through Illinois State Road 3 near Grafton, Illinois. Lastly, samples were collected as drill cuttings obtained from the Indiana Geological Survey (IGS) and the Illinois State Geological Survey (ISGS). A total of 26 wells were chosen covering the boundaries of the Illinois basin. Available well log data was compiled using

Petra Software. Examination and interpretation of the available wireline logs (gamma-ray) were used; to construct structural cross sections, to observe changes in identification and correlation of formation boundaries, as well as, create contour maps to observe depths of samples collected across the basin.

Two methods were used to prepare thin sections. Samples collected from the outcrop and core were prepared using standard methods at Ball State University. Thin sections for standard petrography were polished to a standard thickness of 30μm. The thin sections were then stained in order to differentiate common rock forming carbonate minerals in thin section. Drill cuttings samples were sent to Wagner Petrographic in Lindon, Utah to be made in 24 thin sections. Thin sections were vacuum impregnated with blue epoxy in order to see porosity in thin section. Thin sections were photographed and subsequently loaded into a digital image analysis software called Rock.AR.

Microfacies associations are defined based on the microscopic features of the sedimentary rocks. There was a total of thirteen microfacies identified. Primary intergranular and secondary intragranular porosity dominates the formation but fracture porosity is also present. Overall, porosity in the Rockford is very low with an average for all samples at 2.07%. A porosity % vs. depth graph was produced. The overall trend shows that porosity decreases with depth of burial.

The overall depositional environment varies from Illinois Chouteau deposition to Indiana Rockford deposition. The Chouteau was deposited on a prograding carbonate platform, whereas the Rockford in east-central Indiana was deposited on a vast, deep shelf. The Rockford is likely part of a condensed section. The Rockford is characterized by a very slow sedimentation rate over a long period of time. In the Rockford, bioclasts and glauconitic material tend to be concentrated compared with rapidly deposited sections that contain few fossils. The Rockford/Chouteau was

deposited around 358 Mya, correlating with the beginning of a subsidence event in the Illinois Basin. The subsidence of the basin caused more accommodation space, which in turn, caused greater water depths and increased circulation in the deep basin. Porosity in the deepest parts of the basin where oil is most common in overlying reservoirs, is <2% in the Rockford/Chouteau. Lack of porosity can largely be explained by mechanical and chemical compaction due to deep burial. Lack of hydrocarbon potential can be explained by very poor porosity and is supported by the absence of residues or traces of hydrocarbons in the Rockford/Chouteau Formation.